FIG.1

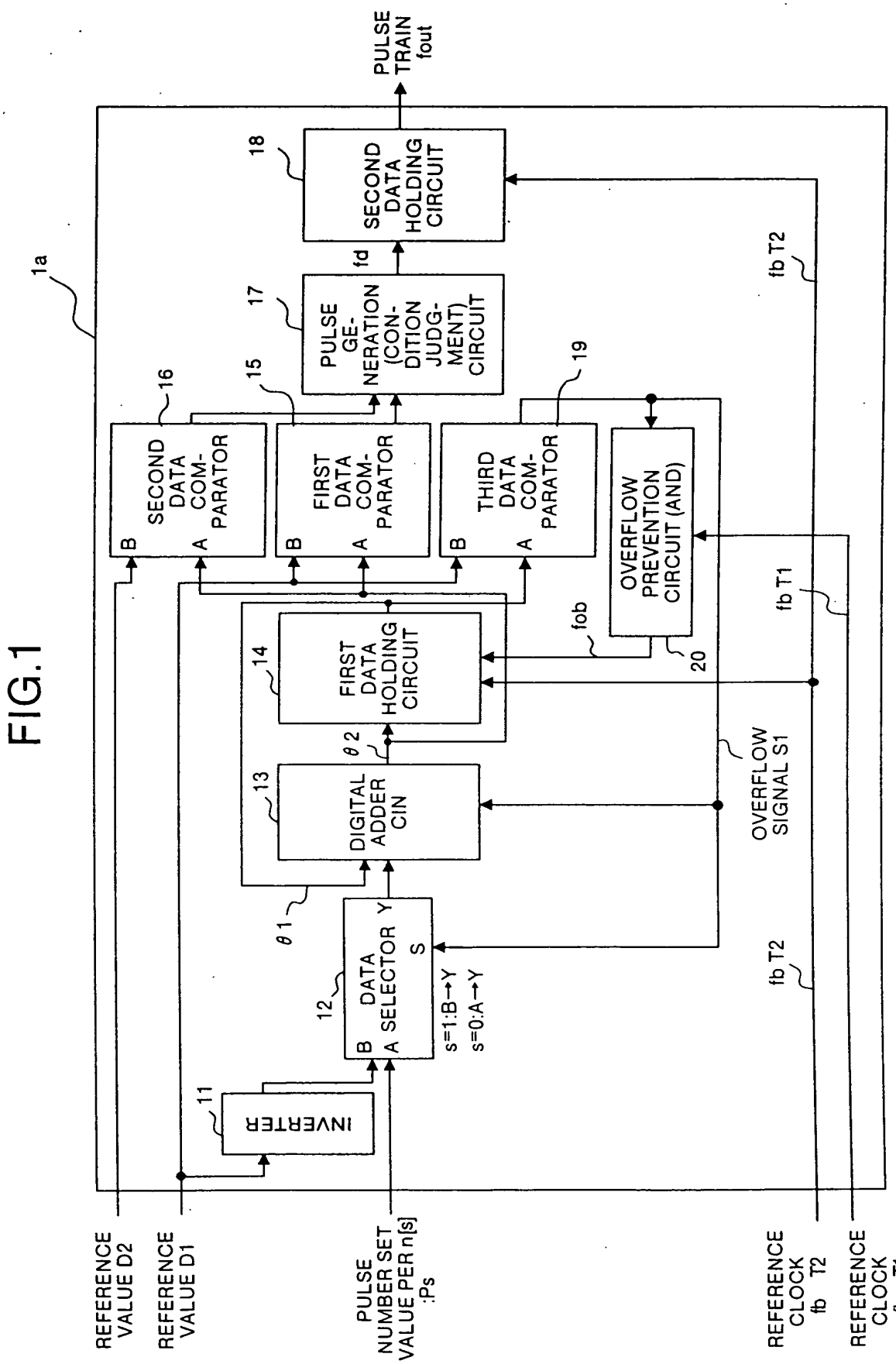

1a
PULSE TRAIN fout
18
SECOND DATA HOLDING CIRCUIT
fd
17
PULSE GE-NERATION (CON-DITION JUDG-MENT) CIRCUIT
16
15
19
SECOND DATA COM-PARATOR
FIRST DATA COM-PARATOR
THIRD DATA COM-PARATOR
OVERFLOW PREVENTION CIRCUIT (AND)
fb T2
fb T1
fob
20
14
FIRST DATA HOLDING CIRCUIT
θ2
13
DIGITAL ADDER CIN
OVERFLOW SIGNAL S1
θ1
12
DATA SELECTOR
B
A
Y
S
s=1:B→Y
s=0:A→Y
11
INVERTER
REFERENCE VALUE D2
REFERENCE VALUE D1
PULSE NUMBER SET VALUE PER n[s] :Ps
REFERENCE CLOCK fb T2
REFERENCE CLOCK fb T1

FIG.2

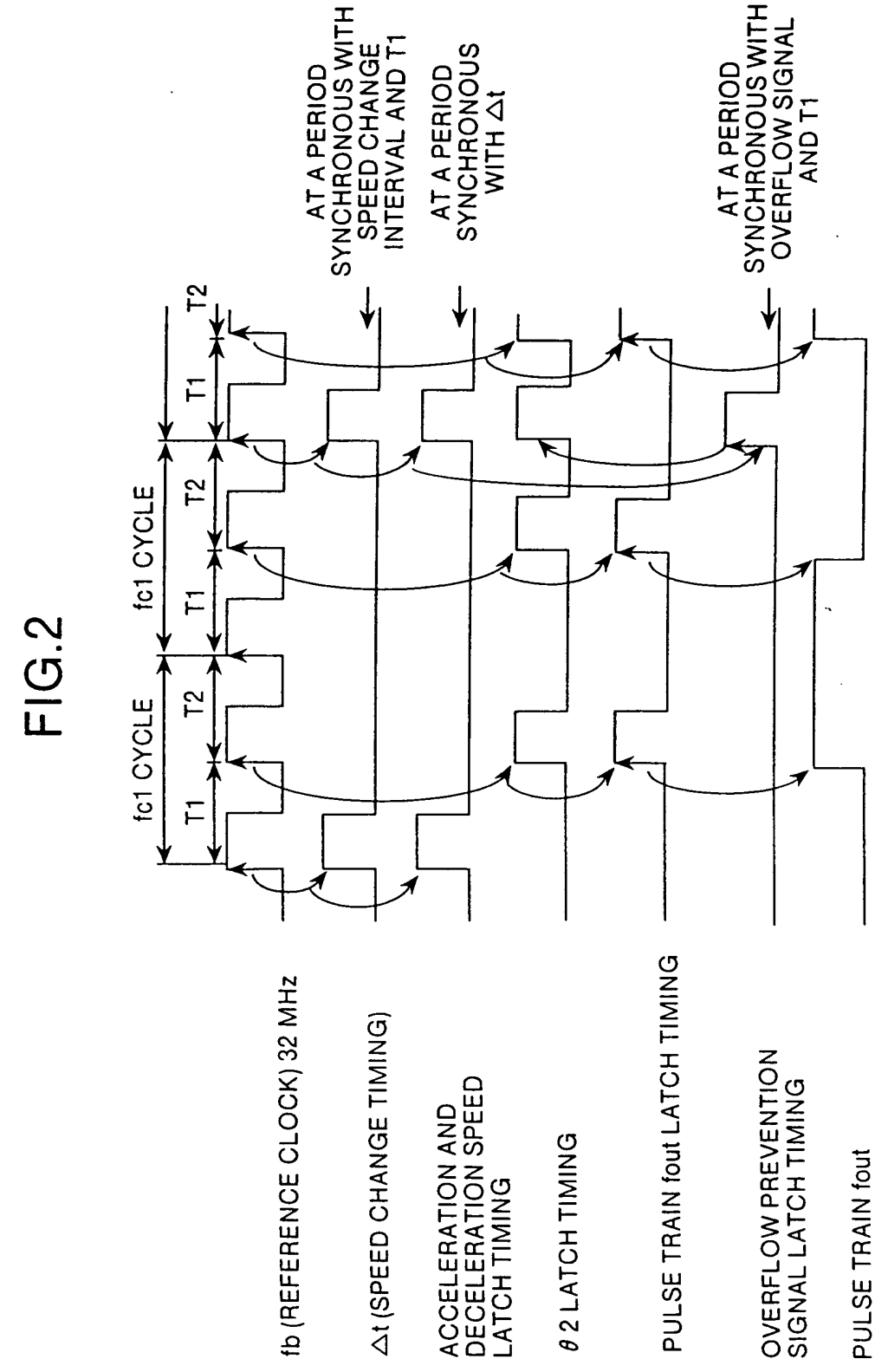

fb (REFERENCE CLOCK) 32 MHz
Δt (SPEED CHANGE TIMING)
ACCELERATION AND DECELERATION SPEED LATCH TIMING
θ 2 LATCH TIMING
PULSE TRAIN fout LATCH TIMING
OVERFLOW PREVENTION SIGNAL LATCH TIMING
PULSE TRAIN fout (AS AN EXAMPLE, 8 MHZ)
fc1 CYCLE
T1
T2
AT A PERIOD SYNCHRONOUS WITH SPEED CHANGE INTERVAL AND T1
AT A PERIOD SYNCHRONOUS WITH Δt
AT A PERIOD SYNCHRONOUS WITH OVERFLOW SIGNAL AND T1

FIG.3

ELAPSED TIME [S]	Vp× n [Hz× n]	OUTPUT VALUE θ1 OF FIRST DATA HOLDING CIRCUIT 14	OVERFLOW SIGNAL θ1≧ D1 WHEN 1	OUTPUT VALUE θ2 OF DIGITAL ADDER 13	VALUE fd	VALUE fout (LATCHED AT T2)
0/32,000,000	0 (INITIAL VALUE)	0 (INITIAL VALUE)	0 (INITIAL VALUE)	0 (INITIAL VALUE)	0 (INITIAL VALUE)	0 (INITIAL VALUE)
1/32,000,000 (T1)	8,000,000	0	0	θ1+Vp× n =8,000,000	0	0
2/32,000,000 (T2)	8,000,000	θ2 IMMEDIATELY BEFORE = 8,000,000	0	θ1+Vp× n =16,000,000	1	fd IMMEDIATELY BEFORE = 0
3/32,000,000 (T1)	8,000,000	HOLD PREVIOUS θ1 = 8,000,000	0	θ1+Vp× n =16,000,000	1	0
4/32,000,000 (T2)	8,000,000	θ2 IMMEDIATELY BEFORE = 16,000,000	0	θ1+Vp× n =24,000,000	1	fd IMMEDIATELY BEFORE = 1
5/32,000,000 (T1)	8,000,000	HOLD PREVIOUS θ1 = 16,000,000	0	θ1+Vp× n =24,000,000	1	1
6/32,000,000 (T2)	8,000,000	θ2 IMMEDIATELY BEFORE = 24,000,000	0	θ1+Vp× n =32,000,000	0	fd IMMEDIATELY BEFORE = 1
7/32,000,000 (T1)	8,000,000	HOLD PREVIOUS θ1 = 24,000,000	0	θ1+Vp× n =32,000,000	0	1
8/32,000,000 (T2)	8,000,000	θ2 IMMEDIATELY BEFORE = 32,000,000	1	θ1− D1=0	0	fd IMMEDIATELY BEFORE = 0
9/32,000,000 (T1)	16,000,000	θ2 IMMEDIATELY BEFORE = 0	0	θ1+Vp× n =16,000,000	1	0
10/32,000,000 (T2)	16,000,000	θ2 IMMEDIATELY BEFORE = 16,000,000	0	θ1+Vp× n =32,000,000	0	fd IMMEDIATELY BEFORE = 1
11/32,000,000 (T1)	16,000,000	HOLD PREVIOUS θ1 = 16,000,000	0	θ1+Vp× n =32,000,000	0	1
12/32,000,000 (T2)	16,000,000	θ2 IMMEDIATELY BEFORE = 32,000,000	1	θ1− D1=0	0	fd IMMEDIATELY BEFORE = 0
13/32,000,000 (T1)	16,000,000	θ2 IMMEDIATELY BEFORE = 0	0	θ1+Vp× n =16,000,000	1	0
14/32,000,000 (T2)	16,000,000	θ2 IMMEDIATELY BEFORE = 16,000,000	0	θ1+Vp× n =32,000,000	0	fd IMMEDIATELY BEFORE = 1
15/32,000,000 (T1)	16,000,000	HOLD PREVIOUS θ1 = 16,000,000	0	θ1+Vp× n =32,000,000	0	1
16/32,000,000 (T2)	16,000,000	θ2 IMMEDIATELY BEFORE = 32,000,000	1	θ1− D1=0	0	fd IMMEDIATELY BEFORE = 0

FIG.4

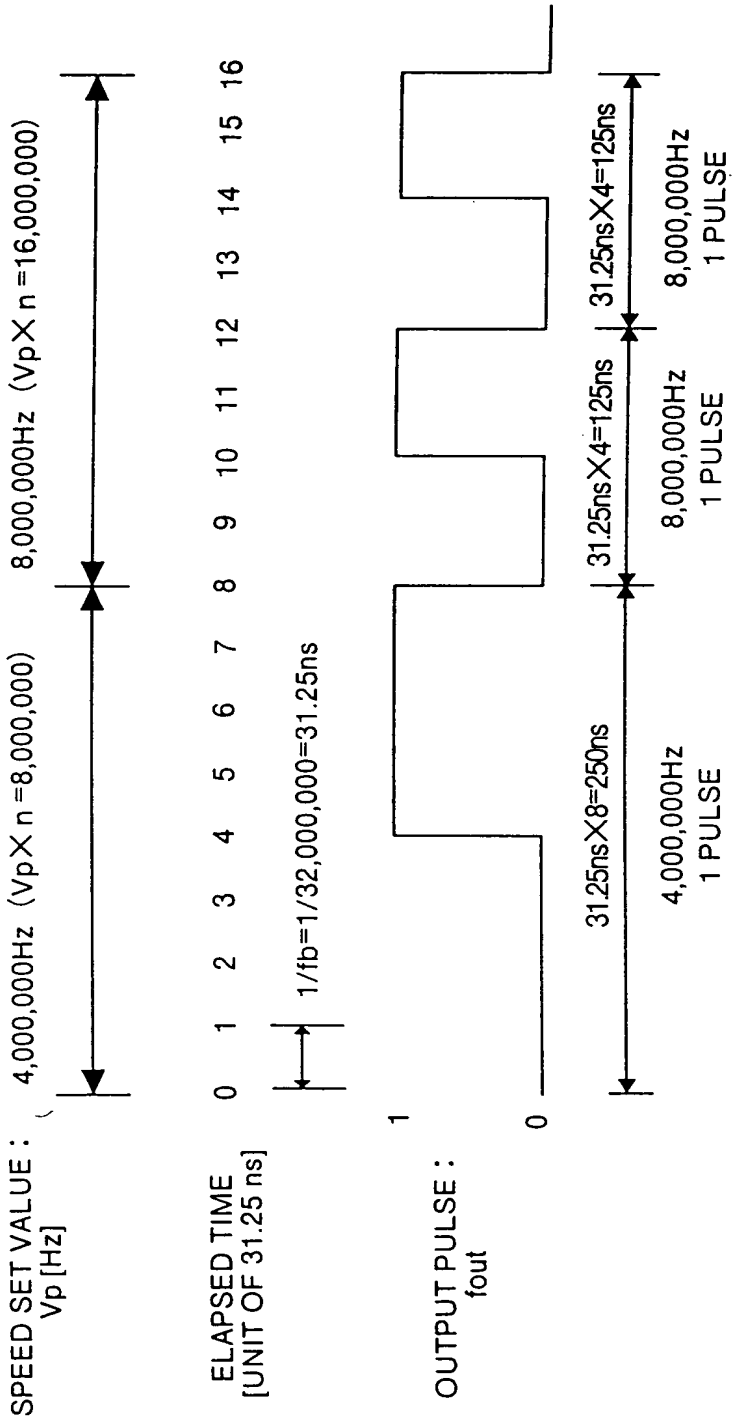

SPEED SET VALUE :
Vp [Hz]
4,000,000Hz (Vp X n =8,000,000)
8,000,000Hz (Vp X n =16,000,000)
ELAPSED TIME
[UNIT OF 31.25 ns]
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
1/fb=1/32,000,000=31.25ns
OUTPUT PULSE :
fout
1
0
31.25ns X8=250ns
4,000,000Hz
1 PULSE
31.25ns X4=125ns
8,000,000Hz
1 PULSE
31.25ns X4=125ns
8,000,000Hz
1 PULSE

FIG.5

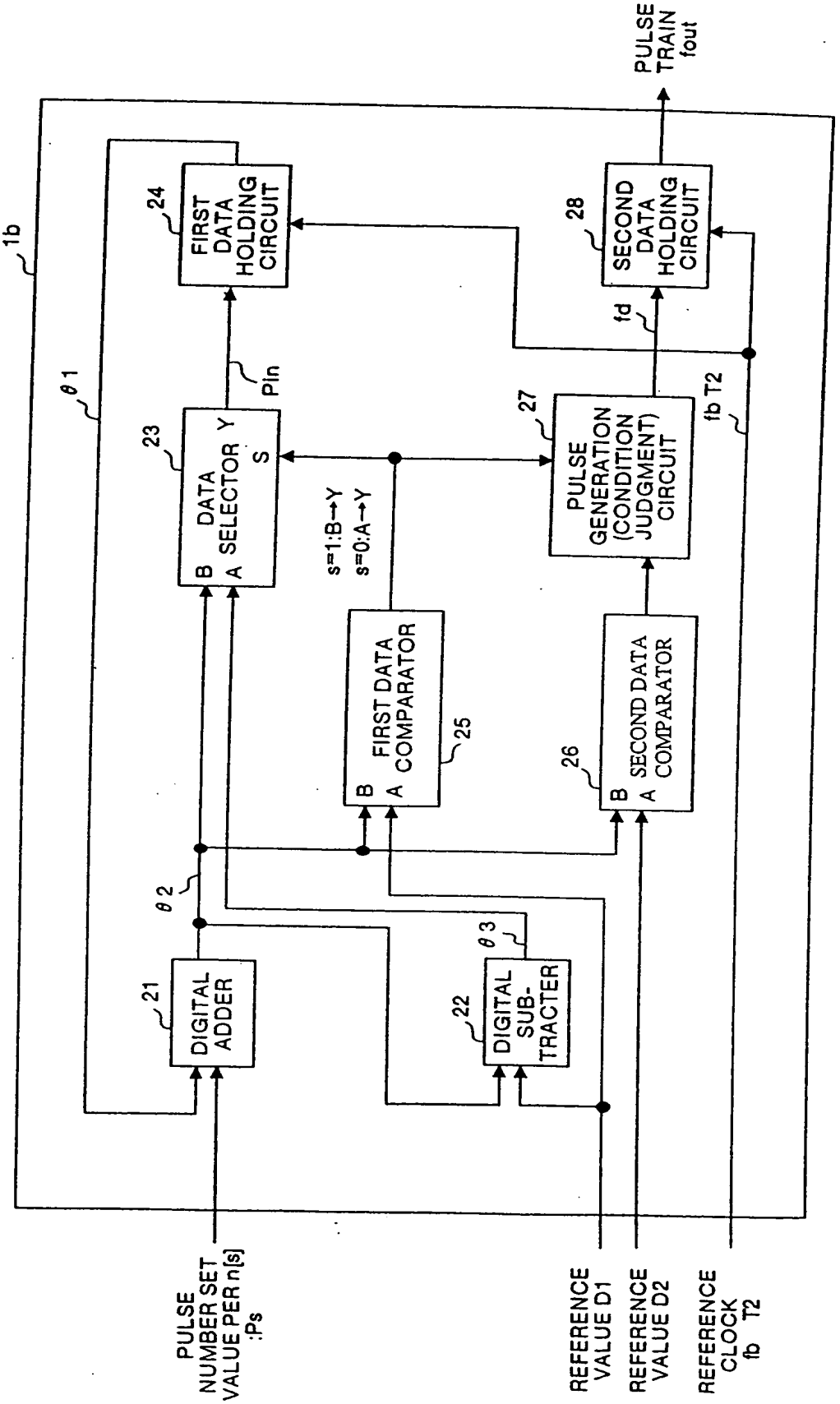

1b
θ1
θ2
θ3
21
DIGITAL ADDER
22
DIGITAL SUB-TRACTER
23
DATA SELECTOR
B
A
Y
S
Pin
24
FIRST DATA HOLDING CIRCUIT
25
FIRST DATA COMPARATOR
s=1:B→Y
s=0:A→Y
26
SECOND DATA COMPARATOR
27
PULSE GENERATION (CONDITION JUDGMENT) CIRCUIT
28
SECOND DATA HOLDING CIRCUIT
td
fb T2
PULSE TRAIN fout
PULSE NUMBER SET VALUE PER n[s] :Ps
REFERENCE VALUE D1
REFERENCE VALUE D2
REFERENCE CLOCK fb T2

FIG.6

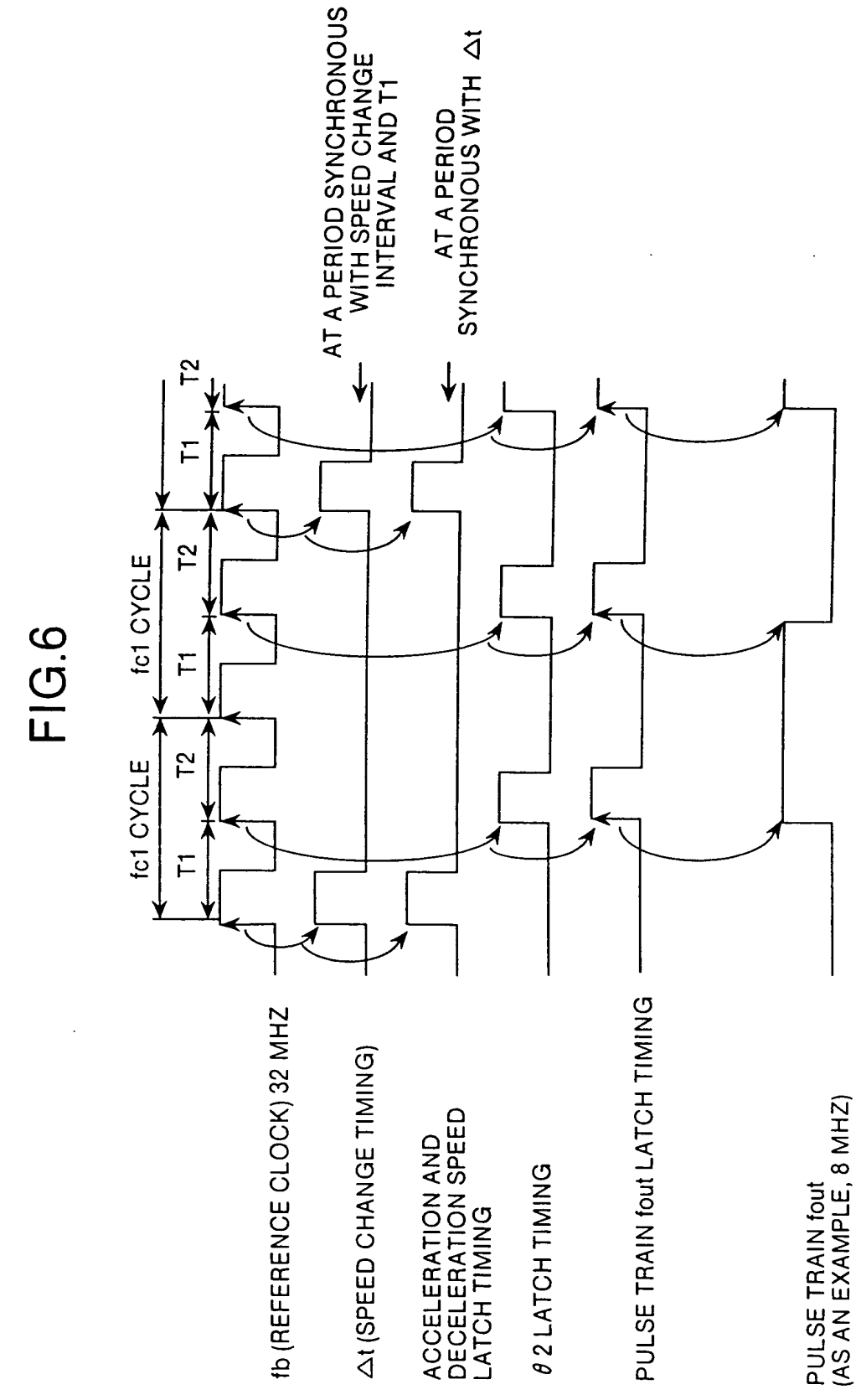

fc1 CYCLE
T1
T2
AT A PERIOD SYNCHRONOUS WITH SPEED CHANGE INTERVAL AND T1
AT A PERIOD SYNCHRONOUS WITH Δt
fb (REFERENCE CLOCK) 32 MHZ
Δt (SPEED CHANGE TIMING)
ACCELERATION AND DECELERATION SPEED LATCH TIMING
θ 2 LATCH TIMING
PULSE TRAIN fout LATCH TIMING
PULSE TRAIN fout (AS AN EXAMPLE, 8 MHZ)

FIG.7

ELAPSED TIME [S]	Vp× n [Hz× n]	OUTPUT VALUE θ1 OF FIRST DATA HOLDING CIRCUIT 14	OUTPUT VALUE OF DIGITAL ADDER 21 θ1+Vp× n = θ2	OUTPUT VALUE OF DIGITAL SUBTRACTER 22 θ2− D1= θ3	VALUE PIN θ2or θ3	VALUE fd	VALUE FOUT (LATCHED AT T2)
0/32,000,000	0 (INITIAL VALUE)	0 (INITIAL VALUE)	0 (INITIAL VALUE)	0 (INITIAL VALUE)	0 (INITIAL VALUE)	0 (INITIAL VALUE)	0 (INITIAL VALUE)
1/32,000,000 (T1)	8,000,000	0	8,000,000	-24,000,000	θ2	0	0
2/32,000,000 (T2)	8,000,000	Pin IMMEDIATELY BEFORE = 8,000,000	16,000,000	-16,000,000	θ2	1	fd IMMEDIATELY BEFORE = 0
3/32,000,000 (T1)	8,000,000	HOLD PREVIOUS θ1 = 8,000,000	16,000,000	-16,000,000	θ2	1	0
4/32,000,000 (T2)	8,000,000	Pin IMMEDIATELY BEFORE = 16,000,000	24,000,000	-8,000,000	θ2	1	fd IMMEDIATELY BEFORE = 1
5/32,000,000 (T1)	8,000,000	HOLD PREVIOUS θ1 = 16,000,000	24,000,000	-8,000,000	θ2	1	1
6/32,000,000 (T2)	8,000,000	Pin IMMEDIATELY BEFORE = 24,000,000	32,000,000	0	θ3	0	fd IMMEDIATELY BEFORE = 1
7/32,000,000 (T1)	8,000,000	HOLD PREVIOUS θ1 = 24,000,000	32,000,000	0	θ3	0	1
8/32,000,000 (T2)	8,000,000	Pin IMMEDIATELY BEFORE = 0	8,000,000	-24,000,000	θ2	0	fd IMMEDIATELY BEFORE = 0
9/32,000,000 (T1)	16,000,000	HOLD PREVIOUS θ1 = 0	16,000,000	-16,000,000	θ2	1	0
10/32,000,000 (T2)	16,000,000	Pin IMMEDIATELY BEFORE = 16,000,000	32,000,000	0	θ3	0	fd IMMEDIATELY BEFORE = 1
11/32,000,000 (T1)	16,000,000	HOLD PREVIOUS θ1 = 16,000,000	32,000,000	0	θ3	0	1
12/32,000,000 (T2)	16,000,000	Pin IMMEDIATELY BEFORE = 0	16,000,000	-16,000,000	θ2	1	fd IMMEDIATELY BEFORE = 0
13/32,000,000 (T1)	16,000,000	HOLD PREVIOUS θ1 = 0	16,000,000	-16,000,000	θ2	1	0
14/32,000,000 (T2)	16,000,000	Pin IMMEDIATELY BEFORE = 16,000,000	32,000,000	0	θ3	0	fd IMMEDIATELY BEFORE = 1
15/32,000,000 (T1)	16,000,000	HOLD PREVIOUS θ1 = 16,000,000	32,000,000	0	θ3	0	1
16/32,000,000 (T2)	16,000,000	Pin IMMEDIATELY BEFORE = 0	16,000,000	-16,000,000	θ2	1	fd IMMEDIATELY BEFORE = 0

FIG.8

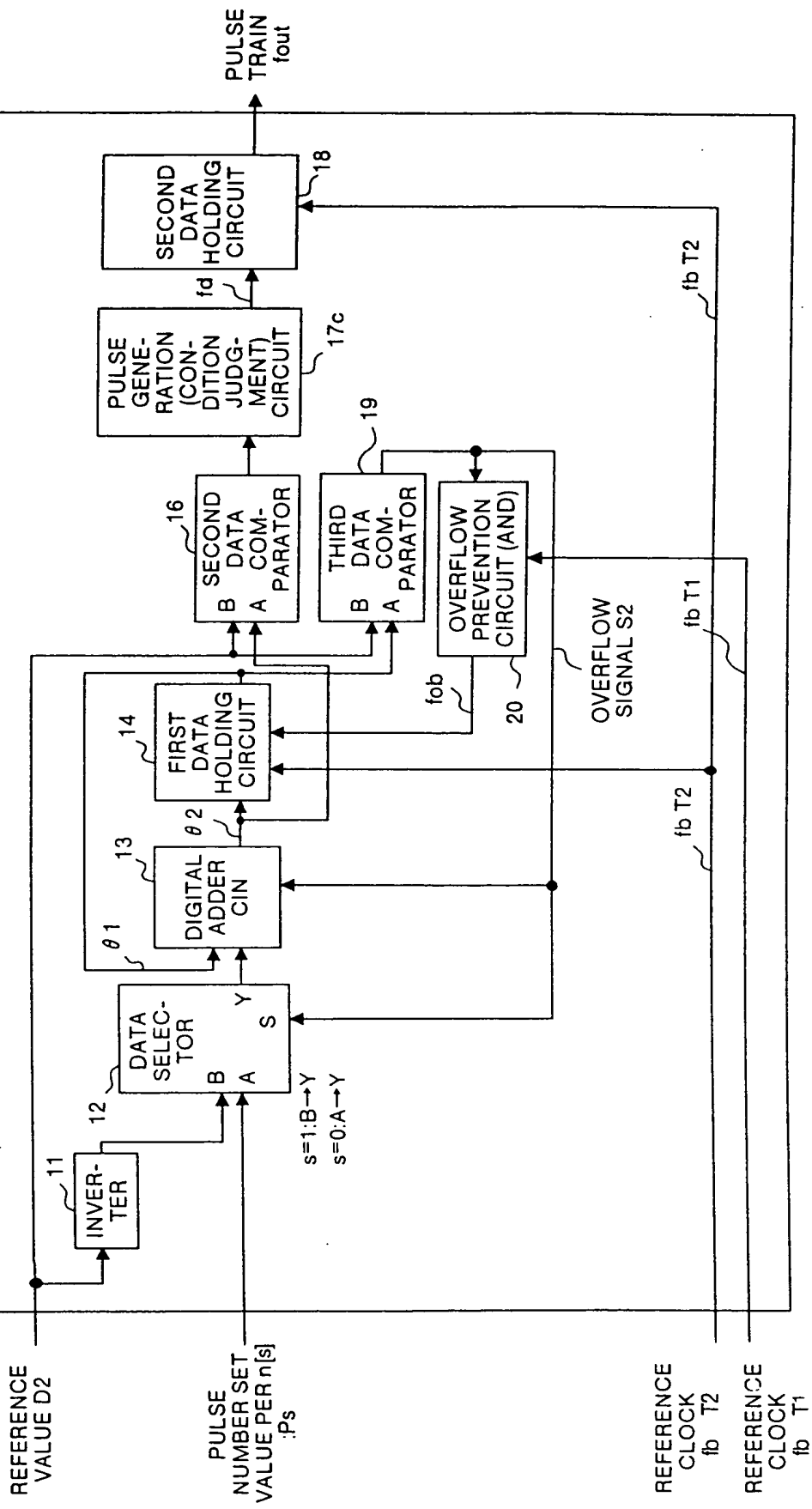

1c
PULSE TRAIN fout
SECOND DATA HOLDING CIRCUIT
18
fd
PULSE GENE-RATION (CON-DITION JUDG-MENT) CIRCUIT
17c
19
SECOND DATA COM-PARATOR
16
THIRD DATA COM-PARATOR
OVERFLOW PREVENTION CIRCUIT (AND)
20
OVERFLOW SIGNAL S2
fob
FIRST DATA HOLDING CIRCUIT
14
θ2
θ1
DIGITAL ADDER CIN
13
DATA SELEC-TOR
12
INVER-TER
11
s=1:B→Y
s=0:A→Y
fb T2
fb T1
REFERENCE VALUE D2
PULSE NUMBER SET VALUE PER n[s] :Ps
REFERENCE CLOCK fb T2
REFERENCE CLOCK fb T1

FIG.9

ELAPSED TIME [S]	Vp× n[Hz× n]	OUTPUT VALUE θ1 OF FIRST DATA HOLDING CIRCUIT 14	OVERFLOW SIGNAL θ1 ≧ D2 WHEN 1	OUTPUT VALUE θ2 OF DIGITAL ADDER 13	VALUE fd	VALUE fout (LATCHED AT T2)
0/32,000,000	0 (INITIAL VALUE)	0 (INITIAL VALUE)	0 (INITIAL VALUE)	0 (INITIAL VALUE)	0 (INITIAL VALUE)	0 (INITIAL VALUE)
1/32,000,000 (T1)	8,000,000	0	0	θ1+Vp× n =8,000,000	0	0
2/32,000,000 (T2)	8,000,000	θ2 IMMEDIATELY BEFORE = 8,000,000	0	θ1+Vp× n =16,000,000	1	fd IMMEDIATELY BEFORE = 0
3/32,000,000 (T1)	8,000,000	HOLD PREVIOUS θ1 = 8,000,000	0	θ1+Vp× n =16,000,000	1	0
4/32,000,000 (T2)	8,000,000	θ2 IMMEDIATELY BEFORE = 16,000,000	1 (ODD NUMBER OF TIMES)	θ1−D2=0	1	fd IMMEDIATELY BEFORE = 1
5/32,000,000 (T1)	8,000,000	θ2 IMMEDIATELY BEFORE = 0	0	θ1+Vp× n =8,000,000	1	1
6/32,000,000 (T2)	8,000,000	θ2 IMMEDIATELY BEFORE = 8,000,000	0	θ1+Vp× n =16,000,000	0	fd IMMEDIATELY BEFORE = 1
7/32,000,000 (T1)	8,000,000	HOLD PREVIOUS θ1 = 8,000,000	0	θ1+Vp× n =16,000,000	0	1
8/32,000,000 (T2)	8,000,000	θ2 IMMEDIATELY BEFORE = 16,000,000	1 (EVEN NUMBER OF TIMES)	θ1−D2=0	0	fd IMMEDIATELY BEFORE = 0
9/32,000,000 (T1)	16,000,000	θ2 IMMEDIATELY BEFORE = 0	0	θ1+Vp× n =16,000,000	1	0
10/32,000,000 (T2)	16,000,000	θ2 IMMEDIATELY BEFORE = 16,000,000	1 (ODD NUMBER OF TIMES)	θ1−D2=0	1	fd IMMEDIATELY BEFORE = 1
11/32,000,000 (T1)	16,000,000	θ2 IMMEDIATELY BEFORE = 0	0	θ1+Vp× n =16,000,000	0	1
12/32,000,000 (T2)	16,000,000	θ2 IMMEDIATELY BEFORE = 16,000,000	1 (EVEN NUMBER OF TIMES)	θ1−D2=0	0	fd IMMEDIATELY BEFORE = 0
13/32,000,000 (T1)	16,000,000	θ2 IMMEDIATELY BEFORE = 0	0	θ1+Vp× n =16,000,000	1	0
14/32,000,000 (T2)	16,000,000	θ2 IMMEDIATELY BEFORE = 16,000,000	1 (ODD NUMBER OF TIMES)	θ1−D2=0	1	fd IMMEDIATELY BEFORE = 1
15/32,000,000 (T1)	16,000,000	θ2 IMMEDIATELY BEFORE = 0	0	θ1+Vp× n =16,000,000	0	1
16/32,000,000 (T2)	16,000,000	θ2 IMMEDIATELY BEFORE = 16,000,000	1 (EVEN NUMBER OF TIMES)	θ1−D2=0	0	fd IMMEDIATELY BEFORE = 0

FIG.10

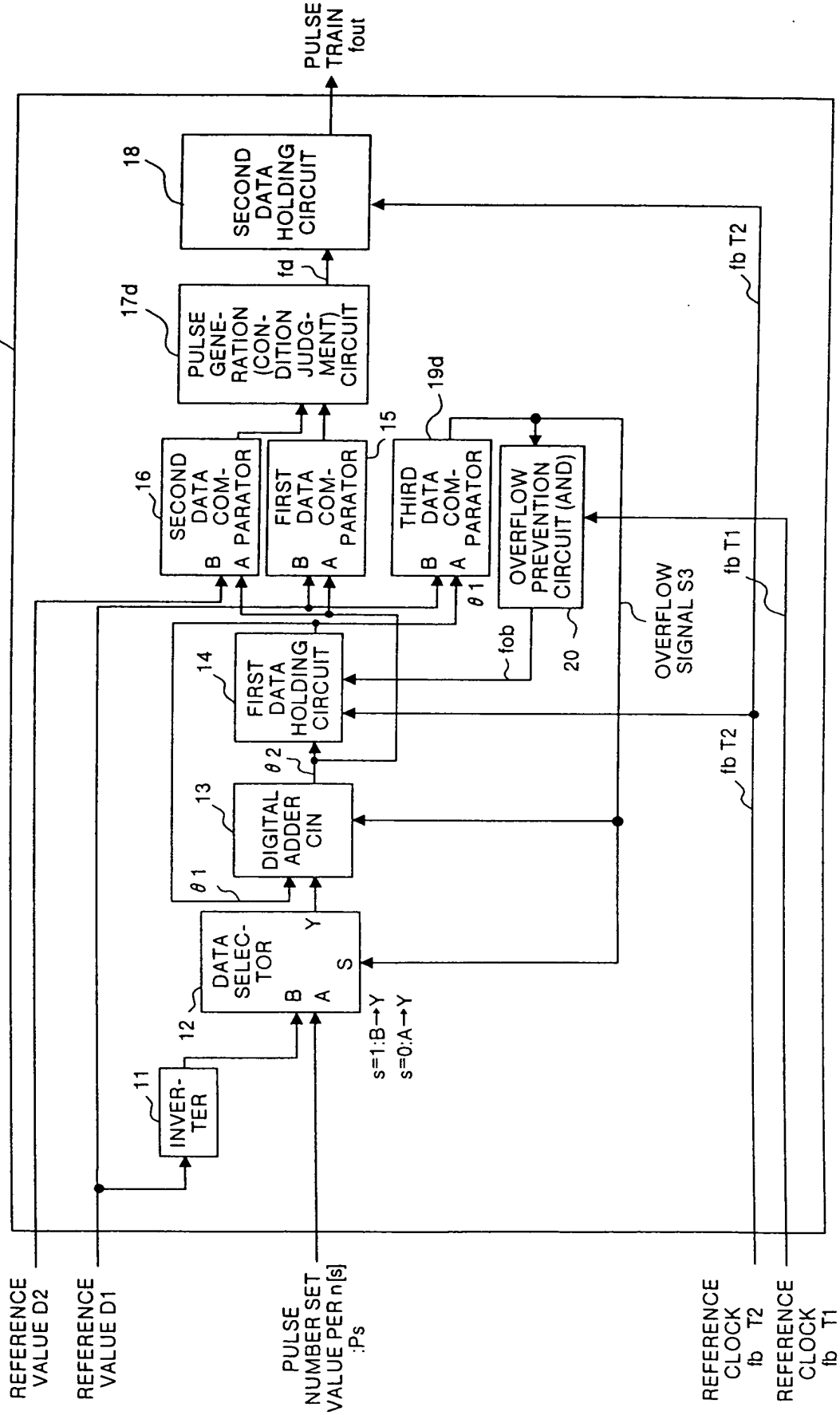

1d
PULSE TRAIN fout
18
SECOND DATA HOLDING CIRCUIT
17d
PULSE GENE-RATION (CON-DITION JUDG-MENT) CIRCUIT
fd
19d
15
16
SECOND DATA COM-PARATOR
FIRST DATA COM-PARATOR
THIRD DATA COM-PARATOR
OVERFLOW PREVENTION CIRCUIT (AND)
20
OVERFLOW SIGNAL S3
fob
θ1
14
FIRST DATA HOLDING CIRCUIT
θ2
13
DIGITAL ADDER CIN
θ1
12
DATA SELEC-TOR
11
INVER-TER
s=1:B→Y
s=0:A→Y
fb T2
fb T1
REFERENCE VALUE D2
REFERENCE VALUE D1
PULSE NUMBER SET VALUE PER n[s] :Ps
REFERENCE CLOCK fb T2
REFERENCE CLOCK fb T1

FIG.11

ELAPSED TIME [S]	Vp× n [Hz× n]	OUTPUT VALUE θ1 OF FIRST DATA HOLDING CIRCUIT 14	OVERFLOW SIGNAL θ1> D1 WHEN 1	OUTPUT VALUE θ2 OF DIGITAL ADDER 13	VALUE fd	VALUE fout (LATCHED AT T2)
0/32,000,000	0 (INITIAL VALUE)	0 (INITIAL VALUE)	0 (INITIAL VALUE)	0 (INITIAL VALUE)	0 (INITIAL VALUE)	0 (INITIAL VALUE)
1/32,000,000 (T1)	8,000,000	0	0	θ1+VpX n =8,000,000	0	0
2/32,000,000 (T2)	8,000,000	θ2 IMMEDIATELY BEFORE = 8,000,000	0	θ1+VpX n =16,000,000	1	fd IMMEDIATELY BEFORE = 0
3/32,000,000 (T1)	8,000,000	HOLD PREVIOUS θ1 = 8,000,000	0	θ1+VpX n =16,000,000	1	0
4/32,000,000 (T2)	8,000,000	θ2 IMMEDIATELY BEFORE = 16,000,000	0	θ1+VpX n =24,000,000	1	fd IMMEDIATELY BEFORE = 1
5/32,000,000 (T1)	8,000,000	HOLD PREVIOUS θ1 = 16,000,000	0	θ1+VpX n =24,000,000	1	1
6/32,000,000 (T2)	8,000,000	θ2 IMMEDIATELY BEFORE = 24,000,000	0	θ1+VpX n =32,000,000	0	fd IMMEDIATELY BEFORE = 1
7/32,000,000 (T1)	8,000,000	HOLD PREVIOUS θ1 = 24,000,000	0	θ1+VpX n =32,000,000	0	1
8/32,000,000 (T2)	8,000,000	θ2 IMMEDIATELY BEFORE = 32,000,000	0	θ1+VpX n =40,000,000	0	fd IMMEDIATELY BEFORE = 0
9/32,000,000 (T1)	16,000,000	HOLD PREVIOUS θ1 = 32,000,000	0	θ1+VpX n =48,000,000	1	0
10/32,000,000 (T2)	16,000,000	θ2 IMMEDIATELY BEFORE = 48,000,000	1	θ1− D1=16,000,000	1	fd IMMEDIATELY BEFORE = 1
11/32,000,000 (T1)	16,000,000	θ2 IMMEDIATELY BEFORE = 16,000,000	0	θ1+VpX n =32,000,000	0	1
12/32,000,000 (T2)	16,000,000	θ2 IMMEDIATELY BEFORE = 32,000,000	0	θ1+VpX n =48,000,000	1	fd IMMEDIATELY BEFORE = 0
13/32,000,000 (T1)	16,000,000	HOLD PREVIOUS θ1 = 32,000,000	0	θ1+VpX n =48,000,000	1	0
14/32,000,000 (T2)	16,000,000	θ2 IMMEDIATELY BEFORE = 48,000,000	1	θ1− D1=16,000,000	1	fd IMMEDIATELY BEFORE = 1
15/32,000,000 (T1)	16,000,000	θ2 IMMEDIATELY BEFORE = 16,000,000	0	θ1+VpX n =32,000,000	0	1
16/32,000,000 (T2)	16,000,000	θ2 IMMEDIATELY BEFORE = 32,000,000	0	θ1+VpX n =48,000,000	1	fd IMMEDIATELY BEFORE = 0

FIG.12

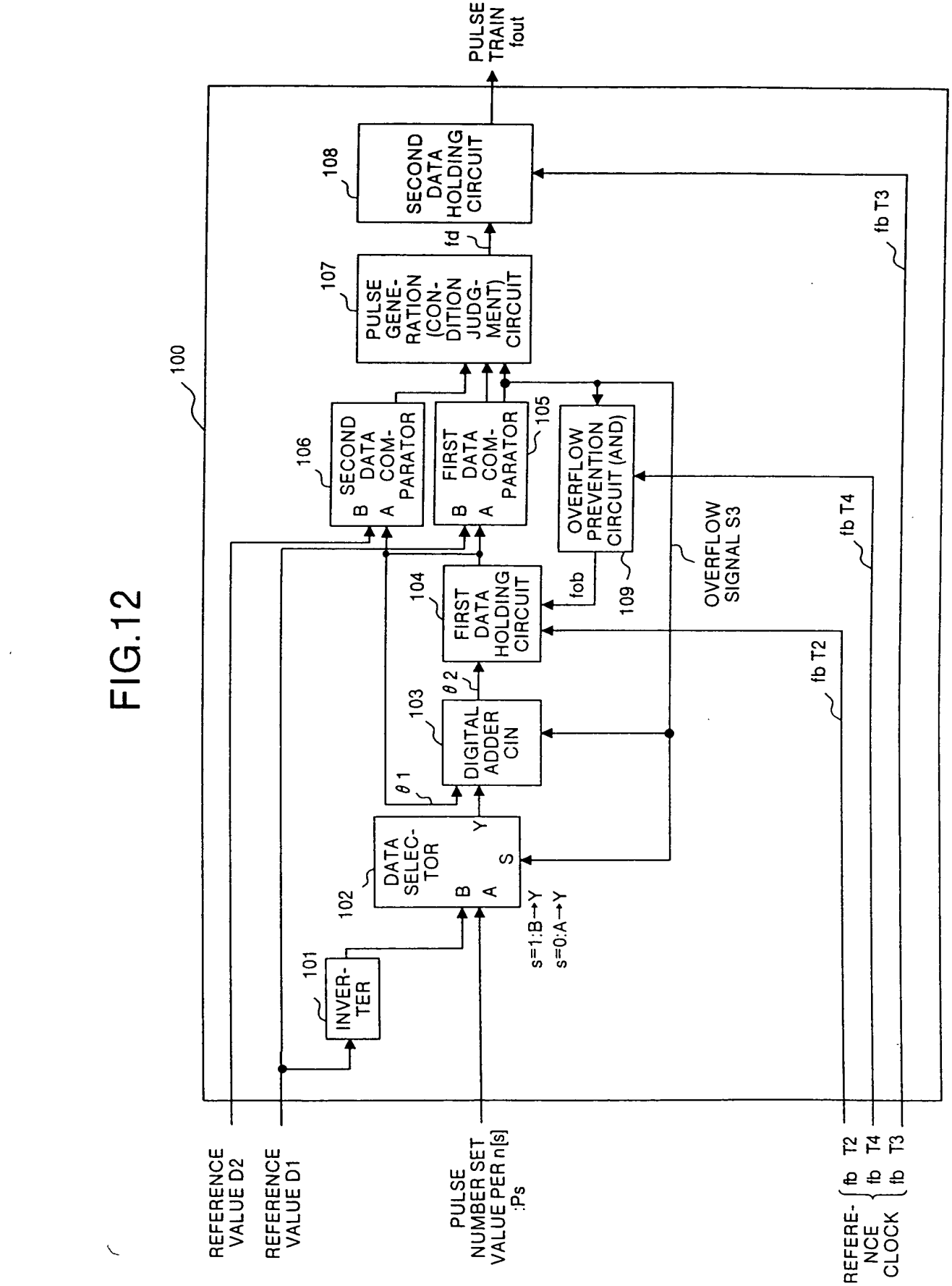
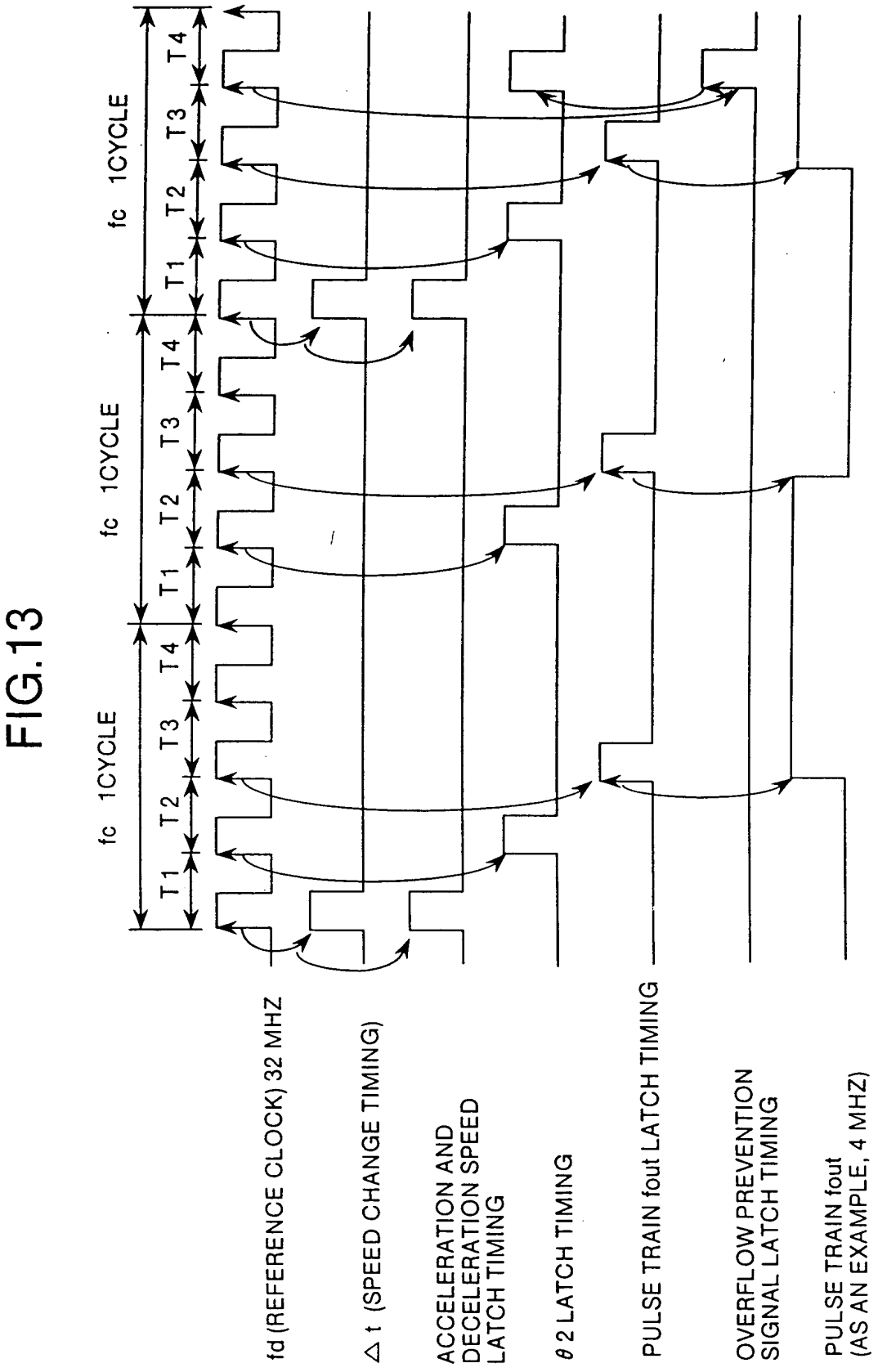

100
PULSE TRAIN fout
108
SECOND DATA HOLDING CIRCUIT
fd
107
PULSE GENE-RATION (CON-DITION JUDG-MENT) CIRCUIT
106
SECOND DATA COM-PARATOR
B
A
105
FIRST DATA COM-PARATOR
OVERFLOW PREVENTION CIRCUIT (AND)
fob
109
OVERFLOW SIGNAL S3
104
FIRST DATA HOLDING CIRCUIT
θ2
103
DIGITAL ADDER CIN
θ1
Y
S
102
DATA SELEC-TOR
B
A
101
INVER-TER
s=1:B→Y
s=0:A→Y
fb T3
fb T4
fb T2
REFERENCE VALUE D2
REFERENCE VALUE D1
PULSE NUMBER SET VALUE PER n[s] :Ps
REFERE-NCE CLOCK
fb T2
fb T4
fb T3

FIG.13


fc 1CYCLE
T1
T2
T3
T4
fd (REFERENCE CLOCK) 32 MHZ
△t (SPEED CHANGE TIMING)
ACCELERATION AND DECELERATION SPEED LATCH TIMING
θ2 LATCH TIMING
PULSE TRAIN fout LATCH TIMING
OVERFLOW PREVENTION SIGNAL LATCH TIMING
PULSE TRAIN fout (AS AN EXAMPLE, 4 MHZ)